A Mean Field Game Theoretic Approach for Security Enhancements in Mobile Ad hoc Networks

Game theory can provide a useful tool to study the security problem in mobile ad hoc networks (MANETs). Most of existing works on applying game theories to security only consider two players in the security game model: an attacker and a defender. While this assumption may be valid for a network with centralized administration, it is not realistic in MANETs, where centralized administration is not available. In this paper, using recent advances in mean field game theory, we propose a novel game theoretic approach with multiple players for security in MANETs. The mean field game theory provides a powerful mathematical tool for problems with a large number of players. The proposed scheme can enable an individual node in MANETs to make strategic security defence decisions without centralized administration. In addition, since security defence mechanisms consume precious system resources (e.g., energy), the proposed scheme considers not only the security requirement of MANETs but also the system resources. Moreover, each node in the proposed scheme only needs to know its own state information and the aggregate effect of the other nodes in the MANET. Therefore, the proposed scheme is a fully distributed scheme. Simulation results are presented to illustrate the effectiveness of the proposed scheme.